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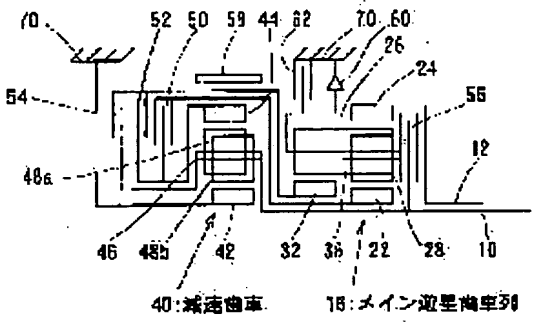
(54) MULTISTAGE TRANSMISSION PLANETARY GEAR TRAIN

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a multistage transmission planetary gear train that is small- sized, lightweight, low in manufacturing cost and high in power transmission efficiency.
SOLUTION: A main planetary gear train 16 having a first member (a first sun gear 22), a second member (a second sun gear 32), a third member (a first carrier 26) and a fourth member (a first ring gear 24) is provided. The first member can be connected to an input shaft 10 at least at a first forward velocity, the second and third members can respectively be connected to the input shaft 10, and the latter can be fixed to a case 70 (stationary part) at least at a highest transmission step (a forward 7th or 8th velocity) while the former can be fixed to the case 70 at least in reversing. The fourth member is connected to an output shaft 12. The input shaft 10 can be connected to the first and second members respectively via a reduction gear 40 with a first reduction ratio, and also to the second and third members respectively at a transmission ratio smaller than the first reduction ratio.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is prepared between an input shaft, an output shaft, and said input shaft and said output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of said input shaft into the engine speed of said output shaft. As said rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While said input shaft and connection are possible for said 1st member in the 1st ** of advance at least and said input shaft and connection are possible for said 2nd member and said 3rd member respectively Said 2nd member is fixable to said case side for the highest gear ratio at least. Said 3rd member could be fixed to said case side at least at the time of go-astern, and said 4th member has connected with said output shaft. Said input shaft The multistage gear change epicyclic gear train characterized by the ability to connect with said 2nd member and said 3rd member with a change gear ratio smaller than said 1st reduction gear ratio through the reduction gear of the 1st reduction gear ratio, respectively that it can connect with said 1st member and said 2nd member, respectively.
[Claim 2] The 3rd pinion A with which said reduction gear meshed with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and said 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and said 3rd pinion A to revolve. Connection or connection is as possible for said input shaft as said 3rd carrier and said 3rd member respectively. It is the multistage gear change epicyclic gear train according to claim 1 characterized by immobilization or immobilization in said case side being possible for said 3rd sun gear, and being able to connect said 3rd ring wheel with said 1st member and said 2nd member, respectively.
[Claim 3] It is prepared between an input shaft, an output shaft, and said input shaft and said output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of said input shaft into the engine speed of said output shaft. As said rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While said input shaft and connection are possible for said 1st member in the 1st ** of advance at least and said input shaft and connection are possible for said 2nd member and said 3rd member respectively Said 2nd member is fixable to a case side for the highest gear ratio at least. Said 3rd member is fixable to said case side at least at the time of go-astern. Said 4th member has connected with said output shaft, and said input shaft can be connected with said 1st member and said 2nd member through the reduction gear of the 1st reduction gear ratio, respectively. And the multistage gear change epicyclic gear train to which a means for said 2nd member and connection to be possible at least, and to fix said 3rd member to said case side with a change gear ratio smaller than said 1st reduction gear ratio is characterized by being mechanical fixed means, such as a dog clutch or the lock pole.
[Claim 4] The 3rd pinion A with which said reduction gear meshed with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and said 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and said 3rd pinion A to revolve. One of said 3rd sun gear and said 3rd carrier and said input shaft are connected. The multistage gear change epicyclic gear train according to claim 3 which enables the immobilization or immobilization of another side of said 3rd sun gear and said 3rd carrier in said case side, and is characterized by constituting said 3rd ring wheel respectively possible [connection] with said 1st member and 2nd member.
[Claim 5] the 1st fixed means which fixes said 2nd member to said case side -- having -- this, while forming the 2nd fixed means which is fixable to said case side through the 1st one-way clutch in the 1st fixed means and juxtaposition Said 3rd sun gear or said 3rd carrier is fixed to said case through the 2nd one-way clutch (3rd

fixed means). A multistage gear change epicyclic gear train given in claims 3 and 4 characterized by forming the 4th fixed means which fixes said 3rd sun gear or said 3rd carrier to said case in this 2nd one-way clutch and juxtaposition.
[Claim 6] The multistage gear change epicyclic gear train according to claim 5 characterized by constituting said 2nd fixed means and said 4th fixed means possible [conclusion] together.
[Claim 7] Said Maine epicyclic gear train is a multistage gear change epicyclic gear train according to claim 1 to 6 characterized by said crankshaft enabling connection to said 3rd member at least while an internal combustion engine's crankshaft can connect with said 1st member and said 2nd member of said Maine epicyclic gear train through a liquid clutch, or a torque converter and said reduction gear, respectively.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the multistage gear change epicyclic gear train which is used for the automatic transmission for cars and which has the change gear ratio of five or more steps of advance.
[0002]
[Description of the Prior Art] Generally as a multistage gear change epicyclic gear train which is known from the former and which has the change gear ratio of five or more steps of advance, the thing given in JP,5-40171,B which this invention person proposed, and the thing given in JP,4-219553,A are known.
[0003]
[Problem(s) to be Solved by the Invention] If it was in the epicyclic gear train given in above-mentioned JP,5-40171,B, although it had seven steps of advance, or eight steps of change gear ratios, there was a problem that the number of friction elements, such as a clutch and a brake, is required for the friction element of 7 thru/or eight pieces, and many in order to obtain these change gear ratios, consequently a manufacturing cost and weight became excessive.
[0004] Moreover, since they produce the drag torque (length shear resistance) when there is a rotation difference, even if friction elements, such as a clutch and a brake, are in the condition do not conclude, they worsen a power transmission efficiency while the number of the friction elements in the condition at the time of transit do not conclude will also increase and generation of heat of the whole change gear will increase especially at the time of high-speed transit, if there are many friction elements, and also have the problem spoil the goodness of special multistage gear change by the fuel consumption engine performance.
[0005] On the other hand, although the change gear ratio of six steps of advance has been obtained using few gearings and friction elements if it is in an epicyclic gear train given in JP,4-219553,A If it is going to enlarge the change gear ratio of the 1st ** of advance so that it can apply to the truck where weight is big Between the change gear ratio of the 3rd ** and the change gear ratios of the 4th ** and between the change gear ratio of the 4th ** and the change gear ratios of the 5th ** separate too much, and there is a problem that the change gear ratio of a gear ratio with high operating frequency tends to become a setup unsuitable on the transit conditions of a car.
[0006] Moreover, like drawing 3 of this official report, when constituted only from an epicyclic gear, there was a problem that it was difficult for the impossible etc. to choose a suitable change gear ratio according to transit conditions, and for it to receive fuel consumption that a change gear ratio obtains that direct connection of 1 does not exist and the number of speeds in which six steps are exceeded.
[0007] This invention aims at acquiring the multistage gear change epicyclic gear train which made it possible to be made in view of such a conventional trouble, and to choose and run a fine change gear ratio according to transit conditions while using as a change gear with a high power transmission efficiency the gear train which has the change gear ratio of five or more steps of advance, the gear train which has the change gear ratio of six or more steps of advance including direct connection, though it is few gearings and a friction element.
[0008]
[Means for Solving the Problem] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 1 in order to attain the above-mentioned purpose It is prepared between an input shaft, an output shaft, and an input shaft and an output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of an input shaft into the engine speed of an output shaft.

As a rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While an input shaft and connection are possible for the 1st member in the 1st ** of advance at least and an input shaft and connection are possible for the 2nd member and the 3rd member respectively The 2nd member is fixable to a case side for the highest gear ratio at least. The 3rd member could be fixed to the case side at least at the time of go-astern, and the 4th member has connected with the output shaft. An input shaft It is characterized by the ability to connect with the 2nd member and the 3rd member with a change gear ratio smaller than the 1st reduction gear ratio through the reduction gear of the 1st reduction gear ratio, respectively that it can connect with the 1st member and the 2nd member, respectively.

[0009] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 2 in order to attain the above-mentioned purpose The 3rd pinion A with which the reduction gear meshed with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and the 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and the 3rd pinion A to revolve. Connection or connection is as possible for an input shaft as the 3rd carrier and the 3rd member respectively, immobilization or immobilization in a case side is possible for the 3rd sun gear, and the 3rd ring wheel is characterized by the ability to connect with the 1st member and the 2nd member, respectively.

[0010] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 3 in order to attain the above-mentioned purpose It is prepared between an input shaft, an output shaft, and an input shaft and an output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of an input shaft into the engine speed of an output shaft. As a rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While an input shaft and connection are possible for the 1st member in the 1st ** of advance at least and an input shaft and connection are possible for the 2nd member and the 3rd member respectively The 2nd member is fixable to a case side for the highest gear ratio at least. Could fix the 3rd member to the case side at least at the time of go-astern, and the 4th member has connected with the output shaft. An input shaft can be connected with the 1st member and the 2nd member through the reduction gear of the 1st reduction gear ratio, respectively. And with a change gear ratio smaller than the 1st reduction gear ratio, the 2nd member and connection are possible at least, and a means to fix the 3rd member to a case side is characterized by being mechanical fixed means, such as a dog clutch or the lock pole.

[0011] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 4 in order to attain the above-mentioned purpose The 3rd pinion A with which the reduction gear meshed with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and the 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and the 3rd pinion A to revolve. One of the 3rd sun gear and the 3rd carrier and an input shaft are connected, the immobilization or immobilization of another side of the 3rd sun gear and the 3rd carrier in a case side is enabled, and it is characterized by constituting the 3rd ring wheel respectively possible [connection] with the 1st member and the 2nd member.

[0012] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 5 in order to attain the above-mentioned purpose the constant means of the 1st ** which fixes the 2nd member to a case side -- having -- this, while forming the 2nd fixed means which is fixable to a case side through the 1st one-way clutch in the 1st fixed means and juxtaposition It is characterized by establishing the 4th fixed means which fixes the 3rd sun gear or the 3rd carrier to a case through the 2nd one-way clutch (3rd fixed means), and fixes the 3rd sun gear or the 3rd carrier to a case at this 2nd one-way clutch and juxtaposition.

[0013] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 6 in order to attain the above-mentioned purpose, it is characterized by constituting the 2nd fixed means and the 4th fixed means possible [conclusion] together.

[0014] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 7 in order to attain the above-mentioned purpose, the Maine epicyclic gear train is characterized by a crankshaft enabling connection to the 3rd member at least while an internal combustion engine's crankshaft can connect with the 1st member of the Maine epicyclic gear train, and the 2nd member through a liquid clutch, or a torque converter and a reduction gear, respectively.

[0015]

[Function] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 1 It is prepared between an input shaft, an output shaft, and an input shaft and an output shaft, and has the Maine

epicyclic gear train equipped with two or more rotation members who change the engine speed of an input shaft into the engine speed of an output shaft. As a rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While an input shaft and connection are possible for the 1st member in the 1st ** of advance at least and an input shaft and connection are possible for the 2nd member and the 3rd member respectively The 2nd member is fixable to a case side for the highest gear ratio at least. The 3rd member could be fixed to the case side at least at the time of go-astern, and the 4th member has connected with the output shaft. An input shaft It writes that connection is possible respectively with the 2nd member and the 3rd member with a change gear ratio smaller than the 1st reduction gear ratio through the reduction gear of the 1st reduction gear ratio that it can connect with the 1st member and the 2nd member, respectively. Gear change of seven steps of advance or two steps of eight-step go-astern is performed in the connection relation between the 1st thru/or the 3rd member, and an input shaft, and the combination of the control which fixes the 2nd member and the 3rd member to a case.

[0016] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 2 The 3rd pinion A with which the reduction gear meshed with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and the 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and the 3rd pinion A to revolve. Connection or connection is as possible for an input shaft as the 3rd carrier and the 3rd member respectively, immobilization or immobilization in a case side is possible for the 3rd sun gear, and the 3rd ring wheel writes that connection is possible respectively with the 1st member and the 2nd member. Gear change of seven steps of advance or two steps of eight-step go-astern is performed in the combination of the control which fixes to a case the 1st thru/or the connection relation between the 3rd member and an input shaft, and the 2nd member and the 3rd member of the Maine epicyclic gear train connected with these.

[0017] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 3 It is prepared between an input shaft, an output shaft, and an input shaft and an output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of an input shaft into the engine speed of an output shaft. As a rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While an input shaft and connection are possible for the 1st member in the 1st ** of advance at least and an input shaft and connection are possible for the 2nd member and the 3rd member respectively The 2nd member is fixable to a case side for the highest gear ratio at least. Could fix the 3rd member to the case side at least at the time of go-astern, and the 4th member has connected with the output shaft. An input shaft can be connected with the 1st member and the 2nd member through the reduction gear of the 1st reduction gear ratio, respectively. And with a change gear ratio smaller than the 1st reduction gear ratio, the 2nd member and connection are possible at least, and a means to fix to a case side writes the 3rd member as mechanical fixed means, such as a dog clutch or the lock pole. At the time of go-astern, a dog clutch or the lock pole fixes the 3rd member to a case, and an inversion drive is performed.

[0018] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 4 The 3rd pinion A with which the reduction gear meshed with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and the 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and the 3rd pinion A to revolve. Connect one of the 3rd sun gear and the 3rd carrier, and an input shaft, and immobilization or immobilization of another side of the 3rd sun gear and the 3rd carrier is enabled at a case side. Since the 3rd ring wheel was constituted respectively possible [connection] with the 1st member and the 2nd member, the moderation drive of the 3rd ring wheel which connected with the 1st member and the 2nd member in any case is carried out, and multistage gear change is performed.

[0019] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 5 While having the 1st fixed means which fixes the 2nd member to a case side and forming the 2nd fixed means which is fixable to a case side through the 1st one-way clutch in the fixed means of this **, and juxtaposition The 3rd sun gear or the 3rd carrier is fixed to a case through the 2nd one-way clutch (3rd fixed means). since the 4th fixed means which fixes the 3rd sun gear or the 3rd carrier to a case was formed in this 2nd one-way clutch and juxtaposition -- the 1st fixed means -- or The 2nd fixed means fixes the 2nd member through the 1st one-way clutch, the 2nd one-way clutch or the 4th fixed means fixes the 3rd sun gear or the 3rd carrier, and multistage gear change is performed.

[0020] If it was in the multistage gear change epicyclic gear train of this invention indicated to claim 6, since

the 2nd fixed means and the 4th fixed means were constituted possible [conclusion] together, by concluding both to coincidence, the 2nd sun gear is fixed through the 1st one-way clutch, the 3rd sun gear or the 3rd carrier is fixed, and multistage gear change is performed.
[0021] If it is in the multistage gear change epicyclic gear train of this invention indicated to claim 7 While an internal combustion engine's crankshaft can connect the Maine epicyclic gear train with the 1st member of the Maine epicyclic gear train, and the 2nd member through a liquid clutch, or a torque converter and a reduction gear, respectively A crankshaft writes that connection to the 3rd member is possible at least. The connection relation of these 1st and 2nd members and input shafts, Gear change of seven steps of advance or two steps of eight-step go-astern is performed in the combination of the control which fixes connection, and 2nd member and 3rd member of a crankshaft and the 3rd member to a case.
[0022]
[Embodiment of the Invention] Hereafter, the embodiment of the multistage gear change epicyclic gear train of this invention is explained based on drawing. Drawing 1 is a skeleton Fig. showing the multistage gear change epicyclic gear train of this invention. An input shaft 10 and an output shaft 12 are the same axial centers, and drawing has drawn **** [axial center] one half. The Maine epicyclic gear train 16 is arranged on the same axial center as an input shaft 10.
[0023] The Maine epicyclic gear train 16 is an epicyclic gear train which is generally called a RABINIYO mold and which combined the single pinion epicyclic gear and the double pinion epicyclic gear. The 1st sun gear 22, The 2nd sun gear 32, the 1st ring wheel 24, and the 1st carrier 26, It consists of a long pinion 38 which is supported to revolve by this 1st carrier 26 and gears with the 1st ring wheel 22 and the 2nd sun gear 32, and a short pinion 28 which is similarly supported to revolve by the 1st carrier 26 and gears with the long pinion 38 and the 1st sun gear 22.
[0024] The reduction gear 40 is formed on the same shaft as an input shaft 10. A reduction gear 40 is a double pinion epicyclic gear of a single row, and consists of 4th pinion 48b which is supported to revolve by the 3rd carrier 46 as well as the 3rd sun gear 42, the 3rd ring wheel 44, and 3rd pinion 48a that is supported to revolve by the 3rd carrier 46 and this 3rd carrier 46, and gears with the 3rd ring wheel 44, and gears with 3rd pinion 48b and the 3rd sun gear 42.
[0025] The 3rd ring wheel 44 can be connected with the 2nd sun gear 32 through the 1st sun gear 22 and the 2nd clutch 52 through the 1st clutch 50, respectively. An input shaft 10 can be connected with the 1st carrier 26 through the 2nd sun gear 32 and the 4th clutch 56 through the 3rd clutch 54, respectively while it is always connected with the 3rd carrier 46.
[0026] The 2nd sun gear 32 is fixable to a case 70 (quiescence section) through the 1st brake 58, and the 1st carrier 26 can also fix the hand of cut of another side to a case 70 by the 2nd brake 62 while only one hand of cut is always fixed to a case 70 through an one-way clutch (OC) 60. Furthermore, the 3rd sun gear 42 is always fixed to a case 70, and the 1st ring wheel 24 is connected with the firm output shaft 12.
[0027] Therefore, since the 3rd carrier 46 is always connected with an input shaft 10 and the 3rd sun gear 42 is always being fixed to the case 70, The 3rd ring wheel 46 will become 1/(1-alpha3), if a moderation drive is always carried out from an input shaft 10 and the ratio [as opposed to the 1st reduction gear ratio, a call, and the number of teeth of the 3rd ring wheel 46 for the reduction gear ratio (rotational frequency of the rotational frequency / the 3rd ring wheel 46 of an input shaft 10)] of the number of teeth of the 3rd sun gear 42 is set to alpha 3. Thus, the 1st sun gear 22 which is driven with the 1st reduction gear ratio and in which the 3rd ring wheel 46 and connection are possible constitutes the 1st member.
[0028] Moreover, in the highest stage (the 8th ** of advance), the 2nd sun gear 32 which is fixable to a case 70 constitutes the 2nd member so that connection may be alternatively [as the 3rd ring wheel 46 and an input shaft 10] possible and it may mention later. Under the present circumstances, when the 2nd member (the 2nd sun gear 32) connects with an input shaft 10, since it is directly linked with an input shaft 10, it will be connected with a change gear ratio smaller than the 1st above-mentioned reduction gear ratio.
[0029] The 1st carrier 26 at least which is fixable to a case 70 constitutes the 3rd member at the time of go-astern so that similarly an input shaft 10 and connection may be possible and it may mention later with a change gear ratio (direct connection) smaller than said 1st reduction gear ratio. Moreover, the 1st ring wheel 24 always connected with the output shaft 12 constitutes the 4th member.
[0030] Next, it explains, referring to the collinear Fig. having shown actuation of the multistage gear change

epicyclic gear train shown in drawing 1 in the actuation table shown in drawing 2 , and drawing 18 . In addition, in the actuation table of drawing 2 , conclusion elements, such as a clutch, and a brake, an one-way clutch, are assigned to the lateral column, and each gear ratio of the 1st ** (1st) of advance thru/or the 8th ** (8th) and the 1st ** (R-1) of go-astern, and the 2nd ** (R-2) is assigned to the column of a lengthwise direction. Although L-1 is the 1st ** of advance, the mode which can also be driven from an output-shaft 12 side like [at the time of engine brake] is expressed. Front Naka and O mark express conclusion of each conclusion element, and a blank expresses release of each conclusion element.

[0031] As for a lengthwise direction, the collinear Fig. shown in drawing 18 expresses the engine speed of each rotation member at the time of setting the engine speed of an input shaft 10 to 1, and a longitudinal direction assigns each rotation member to spacing according to the gear ratio of each above-mentioned epicyclic gear, and has drawn the vertical line. An intersection with the slash and horizontal line in each rotation member's vertical line expresses each rotation member's rotational frequency. Moreover, it expresses that the horizontal line of a broken line is the same rotational frequency. In order to make it intelligible, the intersection in the vertical line of the 4th member's 1st ring wheel 24 connected with the output shaft 12 was expressed as x mark, and other key members' connection and the fixed point were expressed with O.

[0032] Moreover, although alpha 3 used for count of a change gear ratio by the following explanation mentioned above, alpha 1 is the ratio of the number of teeth of the 1st sun gear 22 to the number of teeth of the 1st ring wheel 24, and alpha 2 is the ratio of the number of teeth of the 2nd sun gear 32 to the number of teeth of the 1st ring wheel 24. In the following explanation, a gear ratio alpha 1 is illustrated about the change gear ratio at the time of setting 0.45 and alpha 2 to 0.5, and setting alpha 3 to 0.5. The collinear Fig. shown in drawing 18 is also drawn based on this gear ratio. Furthermore, in the following explanation, a clutch and a brake are called friction element, and these, an one-way clutch, etc. are named generically and it is called a conclusion element.

[0033] Introduction and the 1st ** of advance obtain a change gear ratio by connecting the 3rd ring wheel 44 and the 1st sun gear 22 which is the 1st member by conclusion of the 1st clutch 50. At this time, the 3rd member's 1st carrier 26 is automatically fixed to a case 70 by conclusion of an one-way clutch 60, when driving from an input-shaft 10 side. Since the 3rd ring wheel 44 is always driven with the reduction gear ratio of 1/(1-alpha3) with the reduction gear 40 as mentioned above, if an operation of the Maine epicyclic gear train 16 is also included, the change gear ratio (rotational frequency of the rotational frequency / output shaft 12 of an input shaft 10) of the 1st ** of advance will be set to 1/alpha 1 (1-alpha3).

[0034] That the 1st carrier 26 is fixed to a case 70 with an one-way clutch 60 can obtain the above-mentioned change gear ratio, also in case it drives from an output-shaft 12 side, when driving from an input-shaft 10 side (i.e., when accelerating an automobile, and the above-mentioned change gear ratio was obtained and it fixes to a case 70 by the 2nd brake 62).

[0035] When the collinear Fig. of drawing 18 explains this, a reduction gear 40 Since the 3rd sun gear 42 is being fixed to the case 70, using this rotational frequency as 1 since the 3rd carrier 54 is connected with the input shaft 10 The intersection of an epilogue, this, and the vertical line of the 3rd carrier 44 becomes the rotational frequency of the 3rd carrier 44 with a slash about both, using this rotational frequency as 0, and the 1st member's 1st sun gear 22 is driven at the same rotational frequency.

[0036] On the other hand, since the 3rd member's 1st carrier 26 was fixed to a case 70 and a rotational frequency was set to 0, the slash expressed with 1st connected this and the rotational frequency of the 1st sun gear 22. The intersection of this slash and the vertical line of the 1st ring wheel 24 which is the 4th member is the rotational frequency of the output shaft 12 expressed with x mark. When it considers as the above-mentioned gear ratio, the change gear ratio of the 1st ** of advance is set to 4.444.

[0037] Next, in addition to conclusion of the 1st clutch 50 in the 1st ** of advance, gear change to the 2nd ** of advance is performed by concluding the 1st brake 58. Namely, if it is by the 1st ** of advance while accelerating an automobile, the 1st carrier 26 is being fixed to the case 70 with the one-way clutch 60 as mentioned above, but if the 2nd member's 2nd sun gear 22 is fixed to a case 70 by the 1st brake 58, as for an one-way clutch 60, immobilization of the 1st carrier 26 will be canceled automatically. Therefore, the 1st member's 1st sun gear 22 drives with the 1st reduction gear ratio, and the 2nd member's 2nd sun gear 32 is fixed to a case 70. This changes, as the collinear Fig. of drawing 18 is shown in the slash of 2nd(s), and the change gear ratio becomes (alpha1+alpha2)/{alpha 1 (1+alpha2)} (1-alpha3). When it considers as the above-mentioned gear ratio, the change gear ratio of the 2nd ** of advance is set to 2.815.

[0038] Next, the gear change to the 3rd ** of advance is in addition to conclusion of the 1st clutch 50 which continues from the 1st ** of advance, releasing the 1st brake 58 and concluding the 2nd clutch 52, and is performed by connecting the 2nd member's 2nd sun gear 32 with the 3rd ring wheel 44. Thereby, as the horizontal line of 3rd(s) in the collinear Fig. of drawing 18 shows, the Maine epicyclic gear train 16 is united, and the whole change gear ratio becomes the same as 1/(1-alpha3) of the reduction gear ratio of a reduction gear 40. When it considers as the above-mentioned gear ratio, the change gear ratio of the 3rd ** of advance is set to 2.000.
[0039] Next, the gear change to the 4th ** of advance is in addition to conclusion of the 1st clutch 50 which continues from the 1st ** of advance, releasing the 2nd clutch 52 and concluding the 3rd clutch 54, and is performed by connecting the 2nd member's 2nd sun gear 32 with an input shaft 10. Thereby, the slash of 4th(s) in the collinear Fig. of drawing 18 comes to show, and a change gear ratio becomes (alpha1+alpha2)/{alpha2(1-alpha1, alpha 3)+alpha1 (1-alpha3)}. When it considers as the above-mentioned gear ratio, the change gear ratio of the 4th ** of advance is set to 1.551.
[0040] Next, the gear change to the 5th ** of advance is in addition to conclusion of the 1st clutch 50 which continues from the 1st ** of advance, releasing the 3rd clutch 54 and concluding the 4th clutch 56, and is performed by connecting the 3rd member's 1st carrier 26 with an input shaft 10. Thereby, the slash of 5th(s) in the collinear Fig. of drawing 18 comes to show, and a change gear ratio becomes 1/(1-alpha1, alpha 3). When it considers as the above-mentioned gear ratio, the change gear ratio of the 5th ** of advance is set to 1.290.
[0041] Next, the gear change to the 6th ** of advance is in addition to conclusion of the 4th clutch 56 of the 5th ** of advance, releasing the 1st clutch 50 and concluding the 3rd clutch 54 again, and is performed by connecting the 2nd member's 2nd sun gear 32 with an input shaft 10. As the horizontal line of 6th(s) in the collinear Fig. of drawing 18 shows, while the Maine epicyclic gear train 16 is united by this, it will connect with an input shaft 10, and a change gear ratio is not concerned with the above-mentioned gear ratio, but becomes direct connection of 1.000.
[0042] next, the gear change to the 7th ** of advance -- advance 5th -- prompt -- ** -- conclusion of the 4th clutch 56 -- in addition, it is releasing the 3rd clutch 54 and concluding the 2nd clutch 52 again, and is carried out by connecting the 2nd member's 2nd sun gear 32 with the 3rd ring wheel 44. Thereby, the slash of 7th(s) in the collinear Fig. of drawing 18 comes to show, and a change gear ratio becomes 1/(1+alpha2, alpha 3). When it considers as the above-mentioned gear ratio, the change gear ratio of the 7th ** of advance turns into an accelerating ratio of 0.800.
[0043] next, the gear change to the 8th ** of advance -- advance 5th -- prompt -- ** -- conclusion of the 4th clutch 56 -- in addition, it is releasing the 2nd clutch 52 and concluding the 1st brake 58 again, and is carried out by fixing the 2nd member's 2nd sun gear 32 to a case 70. Thereby, the slash of 8th(s) in the collinear Fig. of drawing 18 comes to show, and a change gear ratio becomes 1/(1+alpha2). When it considers as the above-mentioned gear ratio, the change gear ratio of the 8th ** of advance turns into an accelerating ratio of 0.667.
[0044] Then, the case of go-astern is explained. The 1st junior ** is performed by immobilization in the case 70 of the 1st carrier 26 of the 3rd member by connection to the 3rd ring wheel 44 by conclusion of the 2nd clutch 52, and the 2nd member's 2nd sun gear 22, and conclusion of the 2nd brake 62, as shown in the train of R-1 in the actuation table of drawing 2 . The 2nd member's 2nd sun gear 22 drives with the 1st reduction gear ratio, by this, since the 1st carrier 26 is fixed to a case 70, an inversion drive is carried out, and as shown in the slash of R-1 in the collinear Fig. of drawing 18 , a change gear ratio is set to -1 / alpha 2 (1-alpha3). When it considers as the above-mentioned gear ratio, the change gear ratio of the 1st ** of go-astern is set to -4.000.
[0045] Next, the gear change to the 2nd ** of go-astern is in addition to conclusion of the 2nd brake 62 in the 1st ** of go-astern, releasing the 2nd clutch 52 and concluding the 3rd clutch 54, and is performed by connecting the 2nd member's 2nd sun gear 32 with an input shaft 10. Thereby, the 2nd member's 2nd sun gear 22 is directly linked with an input 10, and as shown in the slash of R-2 in the collinear Fig. of drawing 18 , a change gear ratio is set to -1 / alpha 2. When it considers as the above-mentioned gear ratio, the change gear ratio of the 2nd ** of go-astern is set to -2.000.
[0046] In order to obtain the change gear ratio in each gear ratio so that it may understand by the above explanation, two pieces can perform gear change for the gear ratio which conclusion elements, such as a clutch, and a brake, an one-way clutch, are always concluded, and adjoined each other only by changing element of one of the two of said two pieces.

[0047] moreover, although detailed explanation is omitted, the actuation table of drawing 2 also shows -- as -- the [advance] -- one-step jump gear change of the 1 prompt 3rd ** etc. -- also setting -- the same -- said two conclusion elements -- it can carry out only by changing inner element of one of the two. Thus, it becomes advantageous [in respect of the ease of carrying out of control] as an epicyclic gear train of an automatic transmission that it can change gears by the change of only one conclusion element. the above-mentioned explanation -- the [advance] -- although it went focusing on the so-called up shifting like gear change to the 1 prompt 2nd ** -- the [advance] -- also in down shifting like gear change to the 3 prompt 2nd **, it is the same.

[0048] Moreover, the change gear ratio of eight steps of advance and two steps of go-astern is obtained by at least six pieces, and friction elements, such as a clutch and a brake, can consist of comparatively few friction elements of a number of speeds. There will also be little length shear resistance which this means that there are few friction elements of not operating [which about / becoming reduction of a manufacturing cost, weight, and a necessary tooth space / and an automobile is running], and these produce. Therefore, it lengthens and leads to there being little generation of heat by the loss of shear resistance etc., and a power transmission efficiency being high.

[0049] The automobile which makes an internal combustion engine the source of power had theoretically the inclination for the direction whose change gear ratio is multistage to result in the number of friction elements increasing, and a power transmission efficiency falling if it is generally made multistage, and spoiling the goodness of multistage-izing in respect of fuel consumption although the acceleration engine performance and fuel consumption become good. According to this invention, fuel consumption can be improved with the acceleration engine performance by controlling to choose a suitable gear ratio according to the transit conditions which the change gear ratio of eight steps of advance is obtained, and change variously by at least six friction elements as mentioned above.

[0050] Although the change gear ratio by the above-mentioned gear ratio is an example suitable for commercial vehicles, such as a truck, it cannot be overemphasized that the gear ratio of alpha1, alpha2, and alpha3 can be made into eight steps of change gear ratios suitable for a passenger car by setting up appropriately. Moreover, since direct connection of 1 exists [a change gear ratio] like the 6th ** of advance together with there being few friction elements, that the efficient drive for which it does not depend on a gearing for a gear ratio with high operating frequency can be performed also contributes to improvement in fuel consumption.

[0051] Furthermore, according to the embodiment of this invention shown in drawing 1 , since the Maine epicyclic gear train 16, a reduction gear 40, and each conclusion element are on the same axial center as an input shaft 10 and an output shaft 12, they can constitute the whole in a compact. This is because the RABINIYO mold epicyclic gear train was used for the Maine epicyclic gear train 16, it used the single row double pinion epicyclic gear for the reduction gear 40, respectively and these were combined. Although the input shaft 10 and the output shaft 12 were drawn by a diagram so that the same right-hand side might be turned to, it cannot be overemphasized that an input shaft 10 can be turned and taken out to left-hand side.

[0052] As mentioned above, among the 1st thru/or the 3rd member of the Maine epicyclic gear train 16, the 1st member (the 1st sun gear 22) and the 2nd member (the 2nd sun gear 32), and connection are possible for an input shaft 10 through the reduction gear of the 1st reduction gear ratio, and the 2nd member (the 2nd sun gear 32) and the 3rd member (the 1st carrier 26), and connection are possible for an input shaft 10 again with a change gear ratio (the above-mentioned example change gear ratio 1) smaller than the 1st reduction gear ratio.

[0053] That is, that an input shaft 10 and connection with two kinds of change gear ratios are possible is the description it is featureless to the former, and, thereby, the 2nd member (the 2nd sun gear 32) can get the change gear ratio of two steps of 8 steps of advance go-astern by few friction elements. Even if the connection relation of this each 1st thru/or 3rd member and input shaft 10 is in other embodiments to drawing 9 shown below, it is the description which is fundamentally common.

[0054] Next, the skeleton of the 2nd embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 3 . Drawing shown below assigns the same number fundamentally to the component part of the same function as the embodiment of drawing 1 , and is drawn on it. Here, it explains focusing on a different part from the embodiment shown in drawing 1 , and explanation of the same part is omitted substantially. While the embodiment of drawing 3 uses an engine 14 as a prime mover and driving an input shaft 10 through a torque converter 72, the points whose connection of the 3rd member's 1st carrier 26 and

the crankshaft 74 of an engine 14 the 4th clutch 56 is enabling differ. A torque converter 72 has the one-way clutch 82 for fixing a pump 76, a turbine 78, a stator 80, and a stator 80 to a case 70.
[0055] Actuation of each conclusion element is the same as the actuation table shown in drawing 2 . Therefore, although it is the actuation same about the 1st ** of advance thru/or the 4th **, and the go-astern to which conclusion of the 4th clutch 56 is not related as the embodiment shown in drawing 1 , the power of an engine 14 is transmitted through a torque converter 72, and becomes a fluid drive.
[0056] However, in the 5th ** of advance, since the 1st member's 1st sun gear 22 drives through a torque converter 72 and a reduction gear 40, and the 1st clutch 50 from a crankshaft 74 and a crankshaft 74 drives the 3rd member's 1st carrier 26 directly through the 4th clutch 56, by Hazama of a crankshaft 74 and an output shaft 12, it becomes mixture of a fluid drive and a mechanical drive, and the so-called power split type of drive. Consequently, it becomes possible to absorb transfer of vibration generated in the drive only by mechanical connection etc. with a torque converter, reducing slipping in the torque convert 72 and raising fuel consumption.
[0057] Similarly, in the 6th ** of advance, since the 2nd member's 2nd sun gear 32 is connected through a torque converter 72 and the 3rd clutch 54 from a crankshaft 74, it becomes mixture of a fluid drive and a mechanical drive. Furthermore, also in the 7th ** of advance, since the 2nd member's 2nd sun gear 32 is connected through a torque converter 72 and a reduction gear 40, and the 2nd clutch 52 from a crankshaft 74, it becomes mixture of a fluid drive and a mechanical drive. In the 8th ** of advance, all power drives mechanically through the 4th clutch 56 from a crankshaft 74.
[0058] Usually, if the example which prepares the direct connection clutch called a lock-up clutch so that it may not be made a fluid drive other than the time of low-speed transit in the interior of a torque converter, and connects a turbine with a crankshaft mechanically is common if it is in the automatic transmission which uses a torque converter, and it is in the embodiment of drawing 3 , it can be said that the lock-up clutch is making the 4th clutch 56 serve a double purpose.
[0059] For this reason, while one friction element which is around the gear train becomes less than a total of five pieces and the embodiment of drawing 1 and aiming at reduction of a manufacturing cost, weight, and a necessary tooth space, much more reduction of length shear resistance is attained, and can improve fuel consumption. Moreover, although drawing 3 expressed the embodiment using a torque converter 72, it is also possible to use a liquid clutch (Froude coupling) instead of a torque converter 72.
[0060] Furthermore, like the embodiment shown in drawing 1 , since the Maine epicyclic gear train 16, a reduction gear 40, and each conclusion element are on the same axial center as an input shaft 10 and an output shaft 12, they can constitute the whole in a compact.
[0061] Although the above configuration differs from drawing 1 in part, if an input shaft 10 and a crankshaft 74 are considered to be the same ranks, the connection relation between the 1st member thru/or the 3rd member, an input shaft 10, and a crankshaft 74 is fundamentally the same as the embodiment of drawing 1 . Also in the embodiment shown in drawing 3 , the epicyclic gear train which has the gear ratio of two steps of 8 steps of advance go-astern by few gearings and friction elements is acquired, and the same effectiveness as the embodiment shown in drawing 1 can be demonstrated.
[0062] Next, the skeleton of the 3rd embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 4 . Here, it explains focusing on a different part from the embodiment shown in drawing 1 , and explanation of the same part is omitted substantially. Like the embodiment shown in drawing 3 , while a torque converter 72 is arranged between the crankshaft 74 of an engine 14, and an input shaft 10, the embodiment of drawing 4 The reduction gear 40 for an input shaft 10 and an output shaft 12 being arranged in parallel, and obtaining the 1st reduction gear ratio is the gearing pair of the 1st driver 90 and the 1st driven wheel 92. The gearing for obtaining a change gear ratio smaller than this is the gearing pair of the 2nd driver 94 and the 2nd driven wheel 96, and it differs from the embodiment of drawing 1 that the 2nd driver 94 is further connected with the crankshaft 74. In addition, the illustrated skeleton has drawn one half under surface than the axial center of an input shaft 10, and **** [axial center / of an output shaft 12] one half.
[0063] Moreover, the configurations of the Maine epicyclic gear train 16 differ. That is, it consists of 2nd epicyclic gear groups 30 which consist of the 1st carrier 36 which supported to revolve the 2nd pinion 38 which gears with the 1st epicyclic gear group 20 which consists of the 1st carrier 26 which supported to revolve the 1st pinion 28 which gears with the 1st sun gear 22, the 1st ring wheel 24, and these, the 2nd sun gear 32 and the

2nd ring wheel 34, and these. The 1st member is the 1st ring wheel 24, and an input shaft 10 and connection are possible for him through the 1st clutch 50 and a reduction gear 40.
[0064] Here, between a reduction gear 40 and an input shaft 10, except the time of the so-called engine brake, the 2nd one-way clutch 64 which transmits torque, and the 5th clutch 66 are formed in the direction always driven from an input shaft 10 in parallel, and power is transmitted through the 2nd one-way clutch 64, and in case it is engine brake, power is transmitted with the 5th clutch 66.
[0065] The 1st sun gear 22 and the 2nd sun gear 32 are connected, and the 2nd member is constituted, and through the 2nd clutch 52 and a reduction gear 40, he is fixable to a case 70 with the 1st brake 58 while an input shaft 10 and connection are possible and a crankshaft 74 and connection are possible through the 3rd clutch 54, and the 2nd driver 94 and the 2nd driven wheel 96.
[0066] Through the 4th clutch 56, and the 2nd driver 94 and the 2nd driven wheel 96, it is fixable to a case 70 with an one-way clutch 60 and the 2nd brake 62 while a crankshaft 74 and connection are possible for the 2nd carrier 36 which constitutes the 3rd member. The 1st carrier 26 and the 2nd ring wheel 34 connect, are constituted, and have connected the 4th member with the output shaft 12.
[0067] Although the above configuration differs from drawing 1 , if an input shaft 10 and a crankshaft 74 are considered to be the same ranks, the connection relation between the 1st member thru/or the 3rd member, an input shaft 10, and a crankshaft 74 is fundamentally the same as the embodiment of drawing 1 . It is the same as that of the embodiment which also showed actuation of a conclusion element fundamentally to drawing 1 and drawing 2 . However, since the 5th clutch 66 does not conclude but power is transmitted only with the 2nd one-way clutch 64 if it is as mentioned above at the time of the drive of advance, it is good during advance transit, with the 1st clutch 50 concluded.
[0068] the [for this reason, / advance] -- in gear change to the 1 prompt 6th **, since the gear change shock of the moderation direction is not produced in an automobile, it becomes easy to do gear change control according to an operation of the 2nd one-way clutch 64. Moreover, the 1st junior ** concludes the 5th clutch 66 regardless of a driving direction. Furthermore, it differing from the embodiment which showed a fluid drive and a mechanical drive having been intermingled to drawing 3 a little, although transfer of power is fundamentally the same is that the 6th ** of advance and the 2nd ** of go-astern become a mechanical drive.
[0069] Since it inputs into the 1st ring wheel 24 with a large diameter and the deddendum stress of the 1st ring wheel 24 can be small managed with the embodiment shown in drawing 4 in the 1st ** of advance on which a big input torque acts especially, there is an advantage that a face width (shaft-orientations die length) can be designed small.
[0070] As mentioned above, although the embodiment and configuration of drawing 1 differ from each other, reduction of length shear resistance is attained and can improve fuel consumption while the embodiment of this invention shown in drawing 4 can also obtain the change gear ratio of two steps of 8 steps of advance go-astern by few gearings and friction elements and they aim at reduction of a manufacturing cost, weight, and a necessary tooth space.
[0071] Next, the skeleton of the 4th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 5 . Here, it explains focusing on a different part from the embodiment shown in drawing 1 , and explanation of the same part is omitted substantially. The Maine epicyclic gear train 16 is the same RABINIYO mold epicyclic gear train as the embodiment of drawing 1 , the embodiment shown in drawing 5 is arranged in parallel like the embodiment which the input shaft 10, and the Maine epicyclic gear train 16 and an output shaft showed to drawing 4 , and between an input shaft 10 and the Maine epicyclic gear trains 16 is connected with two pairs of gearings. Therefore, since the 2nd member's 2nd sun gear 22, and the 3rd member's 1st carrier 26 and input shaft 10 are connected through the gearing pair of the 2nd driver 94 for obtaining a change gear ratio smaller than the 1st reduction gear ratio, and the 2nd driven wheel 96, they do not become direct connection.
[0072] Actuation of each conclusion element is the same with having been shown in drawing 2 , and it is the same as that of the embodiment of drawing 1 that the change gear ratio of two steps of 8 steps of advance go-astern can be obtained of it. Also in the embodiment of this invention shown in drawing 5 , while it is possible to obtain the change gear ratio of two steps of 8 steps of advance go-astern by few gearings and friction elements and aiming at reduction of a manufacturing cost, weight, and a necessary tooth space, reduction of length shear resistance is attained and can improve fuel consumption.

[0073] Next, the skeleton of the 5th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 6 . Here, it explains focusing on a different part from the embodiment shown in drawing 1 , and explanation of the same part is omitted substantially. As for the embodiment shown in drawing 6 , like that the Maine epicyclic gear trains 16 differ and the embodiment of drawing 5 , an input shaft 10, and the Maine epicyclic gear train 16 and an output shaft are arranged in parallel, and that between an input shaft 10 and the Maine epicyclic gear trains 16 is connected with two pairs of gearings differ. That is, the Maine epicyclic gear train 16 consists of 2nd epicyclic gear groups 30 which consist of the 1st carrier 36 which supported to revolve the 2nd pinion 38 which gears with the 1st epicyclic gear group 20 which consists of the 1st carrier 26 which supported to revolve the 1st pinion 28 which gears with the 1st sun gear 22, the 1st ring wheel 24, and these, the 2nd sun gear 32 and the 2nd ring wheel 34, and these.
[0074] The 1st member is the 1st sun gear 22, and an input shaft 10 and connection are possible for him through the 1st clutch 50 and a reduction gear 40. The 2nd member is the 2nd sun gear 32, and through the 2nd clutch 52 and a reduction gear 40, he is fixable to a case 70 with the 1st brake 58 while an input shaft 10 and connection are possible and an input shaft 10 and connection are possible through the 3rd clutch 54, and the 2nd driver 94 and the 2nd driven wheel 96.
[0075] The 2nd carrier 36 which constitutes the 3rd member is connected with the 1st ring wheel 24, and through the 4th clutch 56, and the 2nd driver 94 and the 2nd driven wheel 96, it is fixable to a case 70 with an one-way clutch 60 and the 2nd brake 62 while an input shaft 10 and connection are possible. The 1st carrier 26 and the 2nd ring wheel 34 connect, are constituted, and have connected the 4th member with the output shaft 12.
[0076] Although the above configuration differs from drawing 1 , the connection relation between the 1st member thru/or the 3rd member, and an input shaft 10 is fundamentally [as the embodiment of drawing 1] the same except for not being linked directly by connection to the 2nd member's 2nd sun gear 32 and the 3rd member's 2nd carrier 36, and an input shaft 10. Actuation of each conclusion element is the same with having been shown in drawing 2 , and it is the same as that of the embodiment of drawing 1 that the change gear ratio of two steps of 8 steps of advance go-astern can be obtained of it.
[0077] Also in the embodiment of this invention shown in drawing 6 , while it is possible to obtain the change gear ratio of two steps of 8 steps of advance go-astern by few gearings and friction elements and aiming at reduction of a manufacturing cost, weight, and a necessary tooth space, reduction of length shear resistance is attained and can improve fuel consumption.
[0078] Next, the skeleton of the 6th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 7 . Here, it explains focusing on a different part from the embodiment shown in drawing 1 , and explanation of the same part is omitted substantially. As for the embodiment shown in drawing 7 , like that the Maine epicyclic gear trains 16 differ and the embodiment of drawing 5 , an input shaft 10, and the Maine epicyclic gear train 16 and an output shaft are arranged in parallel, and that between an input shaft 10 and the Maine epicyclic gear trains 16 is connected with two pairs of gearings differ.
[0079] That is, the Maine epicyclic gear train 16 consists of 2nd epicyclic gear groups 30 which consist of the 1st carrier 36 which supported to revolve the 2nd pinion 38 which gears with the 1st epicyclic gear group 20 which consists of the 1st carrier 26 which supported to revolve the 1st pinion 28 which gears with the 1st sun gear 22, the 1st ring wheel 24, and these, the 2nd sun gear 32 and the 2nd ring wheel 34, and these.
[0080] The 1st sun gear 22 and the 2nd ring wheel connect, and are constituted, and an input shaft 10 and connection are possible for the 1st member through the 1st clutch 50 and a reduction gear 40. The 2nd member is the 2nd sun gear 32, and through the 2nd clutch 52 and a reduction gear 40, he is fixable to a case 70 with the 1st brake 58 while an input shaft 10 and connection are possible and an input shaft 10 and connection are possible through the 3rd clutch 54, and the 2nd driver 94 and the 2nd driven wheel 96.
[0081] Through the 4th clutch 56, and the 2nd driver 94 and the 2nd driven wheel 96, it is fixable to a case 70 with an one-way clutch 60 and the 2nd brake 62 while an input shaft 10 and connection are possible for the 1st ring wheel 24 which constitutes the 3rd member. The 1st carrier 26 and the 2nd carrier 36 connect, are constituted, and have connected the 4th member with the output shaft 12.
[0082] Although the above configuration differs from drawing 1 , the connection relation between the 1st member thru/or the 3rd member, and an input shaft 10 is fundamentally [as the embodiment of drawing 1] the same except for not being linked directly by connection to the 2nd member's 2nd sun gear 32, and the 3rd

member's 1st ring wheel 24 and an input shaft 10. Actuation of each conclusion element is the same with having been shown in drawing 2 , and it is the same as that of the embodiment of drawing 1 that the change gear ratio of two steps of 8 steps of advance go-astern can be obtained of it.
[0083] Also in the embodiment of this invention shown in drawing 7 , while it is possible to obtain the change gear ratio of two steps of 8 steps of advance go-astern by few gearings and friction elements and aiming at reduction of a manufacturing cost, weight, and a necessary tooth space, reduction of length shear resistance is attained and can improve fuel consumption.
[0084] Next, the skeleton of the 7th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 8 . Here, it explains focusing on a different part from the embodiment shown in drawing 1 , and explanation of the same part is omitted substantially. Like [the embodiment shown in drawing 8 / although the Maine epicyclic gear train 16 consists of same RABINIYO mold epicyclic gear trains as drawing 1] that connection relation differs and the embodiment of drawing 5 , an input shaft 10, and the Maine epicyclic gear train 16 and an output shaft are arranged in parallel, and that between an input shaft 10 and the Maine epicyclic gear trains 16 is connected with two pairs of gearings differ.
[0085] That is, the Maine epicyclic gear train 16 consists of the 1st sun gear 22, the 2nd sun gear 32, the 1st ring wheel 24, the 1st carrier 26, a long pinion 38 that is supported to revolve by this 1st carrier 26 and gears with the 1st ring wheel 22 and the 1st sun gear 22, and a short pinion 28 which is similarly supported to revolve by the 1st carrier 26 and gears with the long pinion 38 and the 2nd sun gear 32. .
[0086] The 1st member is the 1st sun gear 22, and an input shaft 10 and connection are possible for him through the 1st clutch 50 and a reduction gear 40. The 2nd member is the 2nd sun gear 32, and through the 2nd clutch 52 and a reduction gear 40, he is fixable to a case 70 with the 1st brake 58 while an input shaft 10 and connection are possible and an input shaft 10 and connection are possible through the 3rd clutch 54, and the 2nd driver 94 and the 2nd driven wheel 96.
[0087] Through the 4th clutch 56, and the 2nd driver 94 and the 2nd driven wheel 96, it is fixable to a case 70 with an one-way clutch 60 and the 2nd brake 62 while an input shaft 10 and connection are possible for the 1st ring wheel 24 which constitutes the 3rd member. The 4th member is the 1st carrier 26 and has connected with the output shaft 12.
[0088] Although the above configuration differs from drawing 1 , the connection relation between the 1st member thru/or the 3rd member, and an input shaft 10 is fundamentally [as the embodiment of drawing 1] the same except for connection to the 2nd member's 2nd sun gear 32, and the 3rd member's 1st ring wheel 24 and an input shaft 10 not turning into that it is linked directly. Actuation of each conclusion element is the same with having been shown in drawing 2 , and it is the same as that of the embodiment of drawing 1 that the change gear ratio of two steps of 8 steps of advance go-astern can be obtained of it.
[0089] Also in the embodiment of this invention shown in drawing 8 , while it is possible to obtain the change gear ratio of two steps of 8 steps of advance go-astern by few gearings and friction elements and aiming at reduction of a manufacturing cost, weight, and a necessary tooth space, reduction of length shear resistance is attained and can improve fuel consumption.
[0090] Next, the skeleton of the 8th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 9 . The embodiment and number of speeds which were shown in above-mentioned drawing 1 thru/or above-mentioned drawing 8 differ from each other, and the embodiment shown in drawing 9 enables gear change which is two steps of 7 steps of advance go-astern. Specifically, the configuration of the Maine epicyclic gear train 16 and a reduction gear 40 is the same as drawing 9 and drawing 1 are compared and understood. A different point is that it is both 1st brake (1st fixed means) 58, and the 1st one-way clutch 60 prepared in this and juxtaposition and the 3rd brake (2nd fixed means) 68 that a means to fix the 3rd member's 1st carrier 26 to a case 70 is the mechanical lock device 84, and to fix the 2nd member's 2nd sun gear 32 to a case 70.
[0091] That is, when the 3rd brake 68 is concluded, the 1st one-way clutch 60 fixes the 2nd member's 2nd sun gear 32 to a case 70 automatically only in the direction driven from an input-shaft 10 side, cancels immobilization in hard flow and is pivotable freely to it. And conclusion of the 1st brake 58 fixes the 2nd sun gear 32 to a case 70 irrespective of a hand of cut.
[0092] Moreover, the 3rd sun gear 42 can also fix conclusion of the 3rd brake (4th fixed means) 68 to a case 70 while being fixed to a case 70 by the one direction through the 2nd one-way clutch (3rd fixed means) 64. That

is, only the direction driven from an input-shaft 10 side with the 2nd one-way clutch 64 is automatically fixed to a case 70, and the 3rd sun gear 42 is fixed to a case 70 by conclusion of the 3rd brake 68 irrespective of a driving direction.

[0093] That is, the 3rd sun gear 42 is fixable to a case 70 by concluding the 3rd brake 68 together with fixing the 2nd member's 2nd sun gear 32 to a case 70 through the 1st one-way clutch 60. Therefore, the 2nd fixed means which fixes the 2nd member's 2nd sun gear 32 to a case 70 through the 1st one-way clutch 60, and the 4th fixed means which fixes the 3rd sun gear 42 to a case 70 are the conclusion elements (the 3rd brake 68) of one substantially, and the 2nd sun gear 32 and the 3rd sun gear 42 can be fixed together.

[0094] Next, it explains based on the actuation table having shown actuation of the embodiment shown in drawing 9 in drawing 10 . Although the actuation table shown in drawing 10 has adopted the same way of expressing as the actuation table fundamentally shown in drawing 2 ** (inverse triangle) of the 3rd brake 68 in front Naka and the 2nd ** (2nd) of advance the [advance] -- the [after changing to 1 prompt 2nd speed] -- temporary conclusion before changing gears to the 2 prompt 1st ** being expressed, and with the 2nd clutch 52 in the 5th ** (5th) of advance Although ** (equilateral triangle) of the 3rd brake 68 in the 7th ** (7th) of advance and the 2nd ** (R-2) of go-astern has concluded, it means that it is not related to power transfer.

[0095] the operative condition of drawing 9 -- the inside of the actuation which set like and was explained in the embodiment of drawing 1 -- the 1st ** of advance -- there is nothing -- the operative condition of drawing 1 -- the 2nd ** [like] of advance -- the operative condition of drawing 9 -- it becomes the 1st ** of advance which can be set like. Hereafter, the 3rd ** of advance thru/or the 8th ** of advance in an embodiment of drawing 1 advances one step at a time, and turns into the 2nd ** of advance thru/or the 7th ** in an embodiment of drawing 9 . The formula of a change gear ratio advances similarly.

[0096] In addition, since what was shown in drawing 18 about the collinear Fig., 2nd(s) [in / it is fundamentally the same and / drawing 18], or 8th(s) only advance to 1st in this embodiment thru/or 7th(s), illustration is omitted.

[0097] Although the example of a change gear ratio is hereafter shown like explanation of the embodiment of drawing 1 , each gear ratio alpha 1 is illustrated here about the case where set 0.4 and alpha 2 to 0.6, and alpha 3 is set to 0.55. It fixes in the direction which drives the 2nd member's 2nd sun gear 32 from an input shaft 10 in a case 70 through the 1st one-way clutch 60 by connecting the 3rd ring wheel 34 and the 1st member's 1st sun gear 22 by conclusion of the 1st clutch 50, and conclusion of the 3rd brake 68, and the 1st ** of advance is performed. the change gear ratio of the 1st ** -- the operative condition of drawing 1 -- it is set to 3.472, when it becomes (alpha1+alpha2)/{alpha 1 (1+alpha2)} (1-alpha3) and considers as the above-mentioned gear ratio by the same formula as the 2nd ** which can be set like. When driving from an output-shaft 12 side like [at the time of engine brake], as shown in L-1, in addition to conclusion of the 1st clutch 50 and the 3rd brake 68, regardless of a driving direction, the above-mentioned change gear ratio is obtained by conclusion of the 1st brake 58.

[0098] In addition to conclusion of the 1st clutch 50 in the 1st **, and the 3rd brake 68, gear change to the 2nd ** of advance is performed by connecting the 2nd member's 2nd sun gear 32 with the 3rd ring wheel 44 by conclusion of the 2nd clutch 52. At this time, conclusion (immobilization) of the 1st one-way clutch 60 is canceled automatically. the change gear ratio of the 2nd ** -- the operative condition of drawing 1 -- like the 3rd ** which can be set like, it becomes the same as 1/(1-alpha3) of the reduction gear ratio of a reduction gear 40, and when it considers as the above-mentioned gear ratio, it is set to 2.222.

[0099] In addition, conclusion of the 3rd brake 68 is canceled in advance of gear change to the 3rd next ** of advance. Since the direction which the 3rd sun gear 42 is an operation of the 2nd one-way clutch 64, and is driven from an input-shaft 10 side is automatically fixed to a case 70 even if it cancels conclusion of the 3rd brake 68, there is no change in the drive of the 2nd **. Moreover, when changing gears to the 1st ** in the condition of having canceled conclusion of the 3rd brake 68, by the 2nd ** conversely, it can change gears to the 1st ** by canceling the 2nd clutch 52, after concluding the 3rd brake 68 again in advance of gear change. the [thus,] -- the [the 1 prompt 2nd ** and, and] -- in gear change of the 2 prompt 1st **, since the 1st one-way clutch 60 acts, control out of which a gear change shock cannot come easily can be performed.

[0100] the [advance] -- conclusion of the 1st clutch 50 with which the gear change to the 2 prompt 3rd ** continues from the 1st ** -- in addition, it is canceling conclusion of the 2nd clutch 52 and concluding the 3rd clutch 54, and is carried out by connecting the 2nd member's 2nd sun gear 32 with an input shaft 10. In this

case, even if there is the moment of being in a condition with both 2nd clutch 52 and 3rd clutch 54 near [coincidence] conclusion or it, it only becomes the same change gear ratio as the 5th below-mentioned **, and the gear change shock of a direction which slows down an automobile does not arise. This is an operation of the 2nd one-way clutch 64, and is because it will not be in the condition of taking to the 3rd ** and driving from an output-shaft 12 side. the change gear ratio of the 3rd ** -- the operative condition of drawing 1 -- like the 4th ** which can be set like, it becomes (alpha1+alpha2)/{alpha2(1-alpha1, alpha 3)+alpha1 (1-alpha3)}, and when it considers as the above-mentioned gear ratio, it is set to 1.543.

[0101] The gear change to the 4th ** of advance is in addition to conclusion of the 1st clutch 50 which continues from the 1st **, canceling conclusion of the 3rd clutch 54 and concluding the 4th clutch 56, and is performed by the 3rd member's 1st carrier 26 connecting with an input shaft 10. Even if there is the moment of being in a condition with 3rd clutch 54 and 4th clutch 56 both near [coincidence] conclusion or it, also in this case, it only becomes the same change gear ratio as the 5th below-mentioned **, and the gear change shock of a direction which slows down an automobile does not produce it. This is also an operation of the 2nd one-way clutch 64, and it is because it will not be in the condition of driving from an output-shaft 12 side in the 4th **. Like the 5th ** in the embodiment of drawing 1 , the change gear ratio of the 4th ** becomes 1/(1-alpha1, alpha 3), and when it considers as the above-mentioned gear ratio, it is set to 1.282.

[0102] The gear change to the 5th ** of advance is in addition to conclusion of the 4th clutch 56 in the 4th **, canceling conclusion of the 1st clutch 50 and concluding the 3rd clutch 54 again, and is performed by connecting the 2nd member's 2nd sun gear 32 with an input shaft 10 in addition to the 3rd member's 1st carrier 26. In addition, if the 2nd clutch 52 is concluded in this case, it will become easy to do the gear change control to the 6th next **. The 2nd clutch 52 in this case is not related to power transfer. Like the 6th ** in the embodiment of drawing 1 , the change gear ratio of the 5th ** is not concerned with a gear ratio, but becomes direct connection of 1.000.

[0103] The gear change to the 6th ** of advance is in addition to conclusion of the 4th clutch 56 which continues from the 4th **, and the 2nd clutch 52, canceling conclusion of the 3rd clutch 54 and concluding the 3rd brake 68, and is performed by fixing the 3rd sun gear 42 to a case 70, with the 2nd member's 2nd sun gear 32 and 3rd ring wheel 44 connected. Like the 7th ** in the embodiment of drawing 1 , the change gear ratio of the 6th ** becomes 1/(1+alpha2, alpha 3), and when it considers as the above-mentioned gear ratio, it turns into an accelerating ratio of 0.752.

[0104] The gear change to the 7th ** of advance is in addition to conclusion of the 4th clutch 56 which continues from the 4th **, canceling conclusion of the 2nd clutch 52 and concluding the 1st brake 58, and is performed by fixing the 2nd member's 2nd sun gear 32 to a case 70. Under the present circumstances, although the 3rd brake 68 has been concluded, it is not related to power transfer. Like the 8th ** in the embodiment of drawing 1 , the change gear ratio of the 7th ** becomes 1/(1+alpha2), and when it considers as the above-mentioned gear ratio, it becomes accelerating of 0.625.

[0105] In go-astern, a means to fix the 3rd member's 1st carrier 26 to a case 70 is the same as the embodiment of drawing 1 except for that it is the mechanical lock device 84 and concluding the 3rd brake 68. Under the present circumstances, although the change gear ratio of the 1st ** (R-1) of go-astern is obtained combining conclusion of the lock device 84 and the 3rd brake 68, and conclusion of the 2nd clutch 52 and the change gear ratio of the 2nd ** (R-2) of go-astern is obtained combining conclusion of the 3rd clutch 54 It carries out, and in any case, conclusion of the lock device 84 is preceded, and it concludes the 3rd brake 68 and the 2nd clutch 52, or the 3rd clutch 54 continuously. The formula of a change gear ratio is the same as the embodiment of drawing 1 , when it considers as the above-mentioned gear ratio, the 1st ** of go-astern is set to -3.704, and the 2nd ** is set to -1.667.

[0106] As mentioned above, by six friction elements, the change gear ratio of two steps of 7 steps of advance go-astern including direct connection can be obtained, two one-way clutches 60 and 64 can be made to be able to act, and fuel consumption can be raised by smooth gear change control being possible, choosing a fine change gear ratio according to the transit conditions of an automobile, and driving. especially -- the operative condition of drawing 1 -- since big torque acts at the time of go-astern, a mass fake colander is not obtained but a rotation difference becomes large at the time of high-speed transit, the 2nd brake 62 which suited like has the length shear resistance larger than other friction elements produced here.

[0107] The embodiment shown in drawing 9 writes immobilization in the case 70 of the 3rd member's 1st

carrier 26 only as the time of go-astern, and it is making it seven steps of advance, and it is [is permuting the 2nd brake 62 in the embodiment of drawing 1 by the lock device 84, and] especially effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further. Moreover, it is the big description that control is [that it is hard to be that of a gear change shock] possible, without writing substantially the 2nd fixed means which fixes the 2nd member's 2nd sun gear 32 to a case 70 through the 1st one-way clutch 60, and the 4th fixed means which fixes the 3rd sun gear 42 to a case 70 as the conclusion element (the 3rd brake 68) of one, and increasing the number of conclusion elements. Furthermore, also in the embodiment shown in drawing 9 , that an input shaft 10 and connection are possible for the 2nd member (the 2nd sun gear 32) with two kinds of change gear ratios is the description it is featureless to the former.

[0108] Next, the skeleton of the 9th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 11 . Moreover, the actuation table of this is shown in drawing 12 . Here, it explains focusing on a different part from the embodiment shown in drawing 9 , and explanation of the same part is omitted substantially. The embodiment shown in drawing 11 removes the 3rd clutch 54 of the embodiment shown in drawing 9 while it considers immobilization in the case 70 of the 3rd member's 1st carrier 26 only as the time of go-astern and permutes the 2nd brake 62 in the embodiment of drawing 1 by the lock device 84 like the embodiment shown in drawing 9 .

[0109] Consequently, in the embodiment shown in drawing 9 , the 3rd ** of advance to be concluded and the 2nd ** of go-astern of the 3rd clutch 54 will be omitted. However, since conclusion of the 4th clutch 56 can be substituted for direct connection of the 4th ** of advance, the change gear ratio of one step of 6 steps of advance go-astern can be obtained.

[0110] Next, it explains based on the actuation table having shown actuation of the embodiment shown in drawing 11 in drawing 12 . The semantics of the notation showing conclusion of each conclusion element is the same as the actuation table of drawing 10 . the [advance] -- the operative condition shown in drawing 9 about gear change to the 1 prompt 6th ** -- it is that there is no 3rd ** of advance which can be set like, and that conclusion of the 4th ** (4th) which is linked directly in drawing 11 becomes three clutches 50, 52, and 56, and since others are the same, they omit explanation.

[0111] Although illustration of a collinear Fig. was omitted, it becomes what thinned out the 1st ** (1st) of advance, the 4th ** (4th), and the 2nd ** (R-2) of go-astern among two steps of 8 steps of advance go-astern shown in drawing 18 . Therefore, the formula of a change gear ratio also uses the thing except above 1st ** of advance, 4th **, and 2nd ** of go-astern as it is from explanation of the embodiment shown in drawing 1 . Hereafter, each change gear ratio is illustrated with a formula, using alpha 3 as 0.52 for each gear ratio alpha 1 using 0.36 and alpha 2 as 0.58.

[0112] the 1st ** of advance -- the operative condition of drawing 1 -- like the 2nd ** which can be set like, it becomes (alpha1+alpha2)/{alpha 1 (1+alpha2)} (1-alpha3), and when it considers as the above-mentioned gear ratio, it is set to 3.443. the 2nd ** -- the operative condition of drawing 1 -- like the 3rd ** which can be set like, it becomes the same as the reduction gear ratio of a reduction gear 40, and 1/(1-alpha3), and when it considers as the above-mentioned gear ratio, it is set to 2.083. Like the 5th ** in the embodiment of drawing 1 , the 3rd ** becomes 1/(1-alpha1, alpha 3), and when it considers as the above-mentioned gear ratio, it is set to 1.230. Regardless of a gear ratio, as for the 4th **, a change gear ratio becomes direct connection of 1.000. Like the 7th ** in the embodiment of drawing 1 , the 5th ** becomes 1/(1+alpha2, alpha 3), and when it considers as the above-mentioned gear ratio, it turns into accelerating of 0.768. Like the 8th ** in the embodiment of drawing 1 , the 6th ** becomes 1/(1+alpha2), and when it considers as the above-mentioned gear ratio, it turns into accelerating of 0.633. the same -- go-astern -- the operative condition of drawing 1 -- as well as the 1st ** of go-astern which can be set like, it is set to -1 / alpha 2 (1-alpha3), and when it considers as the above-mentioned gear ratio, it is set to -3.592.

[0113] By five friction elements, the change gear ratio of one step of 6 steps of advance go-astern including direct connection suitable for the change gear of a passenger car can be obtained as mentioned above. Moreover, like the embodiment shown in drawing 9 , two one-way clutches 60 and 64 can be made to be able to act, and fuel consumption can be raised by smooth gear change control being possible, choosing a fine change gear ratio according to the transit conditions of an automobile, and driving. Furthermore, it is the same as the embodiment which showed that it was also effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further especially in permuting the 2nd brake 62 in the embodiment of

drawing 1 by the lock device 84 to drawing 9 .
[0114] Next, the skeleton of the 10th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 13 . The embodiment and part which showed this embodiment to drawing 11 only differ from each other. Here, it explains focusing on a different part from the embodiment shown in drawing 11 , and explanation of the same part is omitted substantially. The connection relation of the reduction gear 40 in the embodiment which showed the embodiment shown in drawing 13 to drawing 11 differs.
[0115] That is, the connection relation between the 3rd sun gear 42 and the 3rd carrier 46 is reversed, the 3rd sun gear 42 has connected with the input shaft 10, and the 3rd carrier 46 is fixable in a case 70. For this reason, although the formula of a change gear ratio differs from the embodiment shown in drawing 11 , actuation of each conclusion element is completely the same as what was shown in drawing 12 , and the change gear ratio of one step of 6 steps of advance go-astern is obtained.
[0116] Hereafter, each change gear ratio is illustrated with a formula, using alpha 3 as 0.50 for each gear ratio alpha 1 using 0.36 and alpha 2 as 0.58. The 1st ** of advance becomes (alpha1+alpha2)/{alpha 1 and alpha 3 (1+alpha2)}, and when it considers as the above-mentioned gear ratio, it is set to 3.305. The 2nd ** becomes the same as the reduction gear ratio of a reduction gear 40, 1/alpha 3, and when it considers as the above-mentioned gear ratio, it is set to 2.000. The 3rd ** becomes 1/{1-alpha1 (1-alpha3)}, and when it considers as the above-mentioned gear ratio, it is set to 1.220. Regardless of a gear ratio, as for the 4th **, a change gear ratio becomes direct connection of 1.000. The 5th ** becomes 1/{1+alpha2 (1-alpha3)}, and when it considers as the above-mentioned gear ratio, it turns into accelerating of 0.775. Like the 8th ** in the embodiment of drawing 1 , the 6th ** becomes 1/(1+alpha2), and when it considers as the above-mentioned gear ratio, it turns into accelerating of 0.633. Similarly, go-astern becomes -1/(alpha 2, alpha 3), and when it considers as the above-mentioned gear ratio, it is set to -3.448.
[0117] The embodiment shown in drawing 13 can obtain the change gear ratio of one step of 6 steps of advance go-astern which includes direct connection suitable for the change gear of a passenger car by five friction elements like the embodiment shown in drawing 11 . Moreover, as the embodiment shown in drawing 9 explained, two one-way clutches 60 and 64 can be made to be able to act, and fuel consumption can be raised by smooth gear change control being possible, choosing a fine change gear ratio according to the transit conditions of an automobile, and driving. Furthermore, it is the same as the embodiment which showed that it was also effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further especially in permuting the 2nd brake 62 in the embodiment of drawing 1 by the lock device 84 to drawing 9 .
[0118] Next, the skeleton of the 11th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 14 . This embodiment is the configuration which combined the torque converter 72 with the embodiment shown in drawing 11 , and that way of combining is the same as that of the embodiment shown in drawing 3 . Here, it explains focusing on a different part from the embodiment shown in drawing 11 and drawing 3 , and explanation of the same part is omitted substantially.
[0119] The embodiment shown in drawing 14 arranges a torque converter 72 between the same reduction gear 40 as the embodiment shown in drawing 11 and the Maine epicyclic gear train 16, and an engine 14, and arranges the 4th clutch 56 in a torque converter 72. Actuation of each conclusion element is fundamentally [as what was shown in drawing 12] the same, and the change gear ratio of one step of 6 steps of advance go-astern is obtained.
[0120] Moreover, since the power of an engine 14 is altogether transmitted to an input shaft 10 via a torque converter 72, the 1st ** of advance and the 2nd ** become a fluid drive, and since a part of power goes into the Maine epicyclic gear train 16 via the 4th clutch 56, the 3rd ** and the 5th ** become mixture of a fluid drive and a mechanical drive in Hazama of a crankshaft 74 and an output shaft 12. As for the 4th ** of advance, and the 6th **, all the power of an engine 14 is mechanically transmitted to an output shaft 12.
[0121] Although explanation of a detail is omitted, the embodiment shown in drawing 14 can obtain the change gear ratio of one step of 6 steps of advance go-astern which includes direct connection suitable for the change gear of a passenger car by five friction elements like the embodiment shown in drawing 11. And since the 4th clutch 56 can be arranged in a torque converter 72, what is necessary is just to arrange four friction elements around an epicyclic gear train, and the whole can be made smaller and lightweight.
[0122] Moreover, as the embodiment shown in drawing 9 explained, two one-way clutches 60 and 64 can be

made to be able to act, and fuel consumption can be raised by smooth gear change control being possible, choosing a fine change gear ratio according to the transit conditions of an automobile, and driving. Furthermore, it is the same as the embodiment which showed that it was also effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further especially in permuting the 2nd brake 62 in the embodiment of drawing 1 by the lock device 84 to drawing 9.

[0123] Next, the skeleton of the 12th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 15. This embodiment removes two one-way clutches 60 and 64 and the 3rd brake 68 which accompanies this from the embodiment shown in drawing 13. Here, it explains focusing on a different part from the embodiment shown in drawing 13, and explanation of the same part is omitted substantially.

[0124] Since the conclusion element which described above the embodiment shown in drawing 15 is lost, the actuation is concluding each conclusion element, as shown in the actuation table shown in drawing 16, and the change gear ratio of one step of 5 steps of advance go-astern is obtained. A collinear Fig. comes to be shown in drawing 20. The 3rd sun gear 42 is [a reduction gear 40] the same with an input shaft 10, a rotational frequency is 1, and since the 3rd carrier 46 is being fixed, that the rotational frequency is 0 differs from what was shown in drawing 18. Moreover, since the number of a clutch or brakes is becoming fewer, it turns out that there are few O marks showing the connection relation by the side of the Maine epicyclic gear train.

[0125] When direct connection of 1.000 will not have a change gear ratio compared with the embodiment shown in drawing 13, and 0.36 and alpha 2 are set to 0.58 and it sets alpha 3 to 0.50 for each gear ratio alpha 1, a concrete change gear ratio will become below if each change gear ratio is illustrated with a formula. Like the embodiment of drawing 13, the 1st ** of advance becomes (alpha1+alpha2)/{alpha 1 and alpha 3 (1+alpha2)}, and when it considers as the above-mentioned gear ratio, it is set to 3.305. It is set to 2.000, when the 2nd ** also becomes the same as the reduction gear ratio of a reduction gear 40, 1/alpha 3 and is similarly made into the above-mentioned gear ratio. The 3rd ** becomes 1/{1-alpha1 (1-alpha3)}, and when it considers as the above-mentioned gear ratio, it is set to 1.220. the 4th ** -- the operative condition of drawing 13 -- it becomes the same as 1/{1+alpha2 (1-alpha3)} of the 5th ** which can be set like, and it becomes accelerating of 0.775 when it considers as the above-mentioned gear ratio. Like the 6th ** in the embodiment of drawing 13, the 5th ** becomes 1/(1+alpha2), and when it considers as the above-mentioned gear ratio, it turns into accelerating of 0.633. Similarly, as well as drawing 13, go-astern becomes -1/(alpha 2, alpha 3), and when it considers as the above-mentioned gear ratio, it is set to -3.448.

[0126] By four friction elements, the change gear ratio of one step of 5 steps of advance go-astern suitable for the change gear of a passenger car can be obtained as mentioned above. Moreover, it is the same as the embodiment which showed that it was also effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further especially in permuting the 2nd brake 62 in the embodiment of drawing 1 by the lock device 84 to drawing 9, drawing 11, drawing 13, and drawing 14. Furthermore, if the 4th clutch 56 is formed in a torque converter combining a torque converter like the embodiment shown in drawing 14, it can constitute only from three friction elements around an epicyclic gear train.

[0127] Next, the skeleton of the 13th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 17. This embodiment enables immobilization of the 2nd sun gear 32 of the embodiment shown in drawing 15 in a case 70 through the 1st one-way clutch 60. Here, it explains focusing on a different part from the embodiment shown in drawing 15, and explanation of the same part is omitted substantially.

[0128] As for the embodiment shown in drawing 17, the sleeve 86 is formed in the case 70. Although illustration of a detail was omitted, the sleeve 86 of a hand of cut is movable to shaft orientations, although fixed to a case 70, and drawing expresses the condition of being in shaft-orientations left-hand side, and fixing the 2nd sun gear 32 to a case 70 through the 1st one-way clutch 60. In other than go-astern, a sleeve 86 is in shaft-orientations left-hand side, as shown in drawing. If this sleeve 86 is moved to right-hand side, the 1st carrier 26 is mechanically fixable to a case 70.

[0129] Next, actuation of the embodiment shown in drawing 17 is explained. Although it is the same as that of what was fundamentally shown in drawing 16, since the 2nd member's 2nd sun gear 32 is being fixed to the case 70 through the 1st one-way clutch 60 about the 1st ** of advance as shown in drawing, actuation of each conclusion element should just conclude the 1st brake 58 that what is necessary is just to conclude the 1st clutch 50 when accelerating an automobile, when driving from an output-shaft 12 side like [at the time of engine

brake].
[0130] Moreover, a junior change gear ratio is obtained by moving a sleeve 86 to right-hand side in go-astern, it fixing the 1st carrier 26 to a case 70 mechanically, and concluding the 2nd clutch 52 after that. Since other actuation is the same as the embodiment shown in drawing 13, explanation of a detail is omitted.
[0131] By four friction elements, the change gear ratio of one step of 5 steps of advance go-astern suitable for the change gear of a passenger car can be obtained as mentioned above. Since the sleeve 86 was formed and immobilization of the 2nd member's 2nd sun gear 32 in a case 70 was especially enabled through the 1st one-way clutch 60, on the occasion of gear change between the 1st ** of advance, and the 2nd **, control which suppresses generating of a gear change shock can be performed easily.
[0132] Moreover, it is the same as the embodiment which showed that it was also effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further especially in permuting the 2nd brake 62 in the embodiment of drawing 1 by the sleeve 86 to drawing 9, drawing 11, drawing 13, and drawing 14.
[0133] Next, the skeleton of the 14th embodiment in the multistage gear change epicyclic gear train of this invention is shown in drawing 19. This embodiment uses the cone friction element 100 for immobilization in the case 70 of the 2nd sun gear 32 in the embodiment shown in drawing 15, and the 1st carrier 26. Here, it explains focusing on a different part from the embodiment shown in drawing 15, and explanation of the same part is omitted substantially.
[0134] It has the helical spline 104 to which the helical spline 102 is formed in the case 70, and the cone friction element 100 engaged with the helical spline 102, and the inside forms the **** 1 cone friction surface 106 and the 2nd friction surface 108. Although the cone friction element 100 omits illustration along with the helical spline 102 while it is movable to shaft orientations (right and left), migration and sticking by pressure are attained with the oil pressure piston at right and left. If it fixes this to a case in contact with cone friction surface 26a of the 1st carrier 26 if sticking by pressure is forced on right-hand side, and it forces it on left-hand side, it means fixing this to a case in contact with the 2nd sun gear and cone friction surface 32a of one.
[0135] If torque acts on the hand of cut as an input shaft 10 where the cone friction element 100 is the same, the helical splines 102 and 104 will move to it to left-hand side, if torque acts on the opposite hand of cut to right-hand side. When accelerating by the 1st ** of advance, with for this reason, the aforementioned oil pressure piston If the cone friction element 100 is forced on left-hand side, the 1st clutch 50 is concluded and it drives from an input shaft 10 The 2nd sun gear 32 tends to rotate in the direction contrary to the hand of cut of an input shaft 10. Cone friction surface 32a and the 1st cone friction surface 106 rub, this friction torque is transmitted to the helical splines 104-102, and the force (thrust) which moves to left-hand side produces the cone friction element 100 here.
[0136] Here, if angle of torsion (lead of a helical spline) of the helical splines 104 and 102 is set up appropriately, with the thrust of the left lateral produced between the helical spline 104 and 102, the friction torque of cone friction surface 32a and the 1st cone friction surface 106 will become large, and it will become the operation which enlarges the thrust to the left-hand side which it produces between the helical spline 104 and 102 further.
[0137] Since the operation which enlarges this thrust breaks out only when accelerating from an input-shaft 10 side (drive), it can bring about the operation near an one-way clutch by controlling appropriately the oil pressure to said oil pressure piston. On the other hand, when driving from an output-shaft 12 side, the torque of hard flow acts between the helical spline 104 and 102, and the thrust of the direction which detaches cone friction surface 32a and the 1st cone friction surface 106 arises. Then, the torque which acts on the 2nd sun gear 32 at the time of engine brake and which should be fixed can be borne now by setting the oil pressure made to act on angle of torsion and the oil pressure piston of the helical splines 104 and 102 as suitable relation.
[0138] Similarly, in go-astern, if the drill friction element 100 is moved to right-hand side at an oil pressure piston and it drives from an input shaft 10, the 1st carrier 26 tends to rotate to the same hand of cut as an input shaft 10, the same operation will break out in the helical splines 104 and 102, cone friction surface 26a, and the 2nd cone friction surface 108, and the operation from which the thrust of the direction fixed to a case 70 produces the 1st carrier 26 will be brought about. The always big force is given to the drill friction element 100 with an oil pressure piston at the time of go-astern, and the drive from an output-shaft 12 side is also enabled.
[0139] Although explanation of a detail is omitted since the operation of other conclusion elements is the same

as the embodiment shown in drawing 15, the change gear ratio of one step of 5 steps of advance go-astern suitable for the change gear of a passenger car can be obtained by three friction elements in addition to drill friction-element 100. Since especially the drill friction element 100 has the function of an one-way clutch, on the occasion of gear change between the 1st ** of advance, and the 2nd **, control which suppresses generating of a gear change shock can be performed easily.

[0140] Moreover, since a cone friction surface can have few friction surfaces, it can lengthen by securing the clearance between the friction surfaces at the time of un-operating and shear resistance can be made small the operative condition of drawing 1 -- it is the same as the embodiment which showed that it was also effective in making small drag resistance at the time of high-speed transit, and raising fuel consumption further especially in permuting the 2nd brake 62 which can be set like by cone friction surface 26a and the 2nd cone friction surface 108 to drawing 9, drawing 11, drawing 13, and drawing 14.

[0141] As mentioned above, as explained, while the following effectiveness is acquired according to the multistage gear change epicyclic gear train of this invention, the conclusion element except having illustrated can be replaced with permuting by juxtaposition of a friction element and an one-way clutch, and the friction element of a multiple disc clutch etc. based on this contractor's general knowledge, and it can carry out in the mode which added modification and amelioration of making it a cone friction element.

[0142]

[Effect of the Invention] As mentioned above, according to the multistage gear change epicyclic gear train of this invention, the following effectiveness can be acquired as explained.

According to the multistage gear change epicyclic gear train of this invention indicated to claim 1, (1) An input shaft, It is prepared between an output shaft, and an input shaft and an output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of an input shaft into the engine speed of an output shaft. As a rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While an input shaft and connection are possible for the 1st member in the 1st ** of advance at least and an input shaft and connection are possible for the 2nd member and the 3rd member respectively The 2nd member is fixable to a case side for the highest gear ratio at least. The 3rd member could be fixed to the case side at least at the time of go-astern, and the 4th member has connected with the output shaft. An input shaft It writes that connection is possible respectively with the 2nd member and the 3rd member with a change gear ratio smaller than the 1st reduction gear ratio through the reduction gear of the 1st reduction gear ratio that it can connect with the 1st member and the 2nd member, respectively. Connection to the 1st thru/or the 3rd member, and an input shaft, and the 2nd member and the 3rd member in combination with few friction elements which fix to a case Since gear change of seven steps of advance or two steps of eight-step go-astern can be performed, it is small and lightweight, a manufacturing cost is cheap, and a change gear with a high power transmission efficiency can be obtained.

[0143] According to the multistage gear change epicyclic gear train of this invention indicated to claim 2, (2) A reduction gear The 3rd pinion A which geared with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and the 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and the 3rd pinion A to revolve. Connection or connection is as possible for an input shaft as the 3rd carrier and the 3rd member respectively, immobilization or immobilization in a case side is possible for the 3rd sun gear, and the 3rd ring wheel writes that connection is possible respectively with the 1st member and the 2nd member. While performing gear change of seven steps of advance, or two steps of eight-step go-astern, the whole epicyclic gear train can be constituted from on the same axis, and a change gear can be used as a compact.

[0144] According to the multistage gear change epicyclic gear train of this invention indicated to claim 3, (3) An input shaft, It is prepared between an output shaft, and an input shaft and an output shaft, and has the Maine epicyclic gear train equipped with two or more rotation members who change the engine speed of an input shaft into the engine speed of an output shaft. As a rotation member of this Maine epicyclic gear train It has the 1st member, the 2nd member, the 3rd member, and the 4th member. While an input shaft and connection are possible for the 1st member in the 1st ** of advance at least and an input shaft and connection are possible for the 2nd member and the 3rd member respectively The 2nd member is fixable to a case side for the highest gear ratio at least. Could fix the 3rd member to the case side at least at the time of go-astern, and the 4th member has connected with the output shaft. An input shaft can be connected with the 1st member and the 2nd member

through the reduction gear of the 1st reduction gear ratio, respectively. And with a change gear ratio smaller than the 1st reduction gear ratio, the 2nd member and connection are possible at least, and a means to fix to a case side writes the 3rd member as mechanical fixed means, such as a dog clutch or the lock pole. Since a mass friction element becomes unnecessary, the length shear resistance in high-speed transit is lowered and a power transmission efficiency increases, while raising fuel consumption further, reduction of a manufacturing cost, weight, and a necessary tooth space can be aimed at.

[0145] According to the multistage gear change epicyclic gear train of this invention indicated to claim 4, (4) A reduction gear The 3rd pinion A which geared with the 3rd sun gear, the 3rd ring wheel, and this 3rd ring wheel The 3rd pinion B which geared with this 3rd pinion A and the 3rd sun gear It has the 3rd carrier which supports this 3rd pinion B and the 3rd pinion A to revolve. Connect one of the 3rd sun gear and the 3rd carrier, and an input shaft, and immobilization or immobilization of another side of the 3rd sun gear and the 3rd carrier is enabled at a case side. Since the 3rd ring wheel was constituted respectively possible [connection] with the 1st member and the 2nd member, according to a necessary reduction gear ratio, one of the 3rd sun gear and the 3rd carrier and an input shaft can be connected, and the setting degree of freedom of a change gear ratio can be raised by fixing another side.

[0146] According to the multistage gear change epicyclic gear train of this invention indicated to claim 5, (5) The 2nd member the 1st fixed means fixed to a case side -- having -- this, while forming the 2nd fixed means which is fixable to a case side through the 1st one-way clutch in the 1st fixed means and juxtaposition The 3rd sun gear or the 3rd carrier is fixed to a case through the 2nd one-way clutch (3rd fixed means). Since the 4th fixed means which fixes the 3rd sun gear or the 3rd carrier to a case was formed in this 2nd one-way clutch and juxtaposition, control which cannot come out of the gear change shock especially in a low-speed stage easily can be made easy.

[0147] (6) According to the multistage gear change epicyclic gear train of this invention indicated to claim 6, making easy control out of which utilizes the 1st one-way clutch and the 2nd one-way clutch, and a gear change shock cannot come easily, since the 2nd fixed means and the 4th fixed means were constituted possible [conclusion] together, it can constitute without making [many] the number of friction elements.

[0148] According to the multistage gear change epicyclic gear train of this invention indicated to claim 7, (7) The Maine epicyclic gear train While an internal combustion engine's crankshaft can connect with the 1st member of the Maine epicyclic gear train, and the 2nd member through a liquid clutch, or a torque converter and a reduction gear, respectively Since one friction element can be reduced as a whole while a crankshaft has the function to write that connection is possible to the 3rd member, and to give him gear change of seven steps of advance, or two steps of eight-step go-astern at least, it is small and lightweight, a manufacturing cost is cheap, and a change gear with a high power transmission efficiency can be obtained.

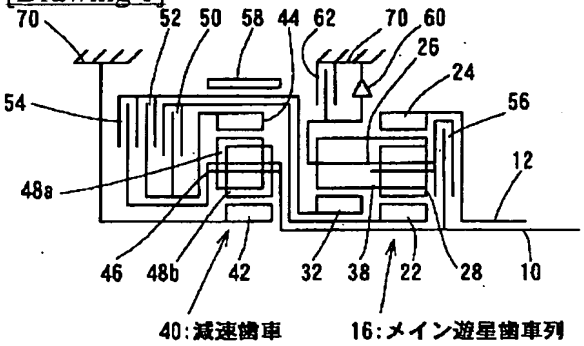
[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

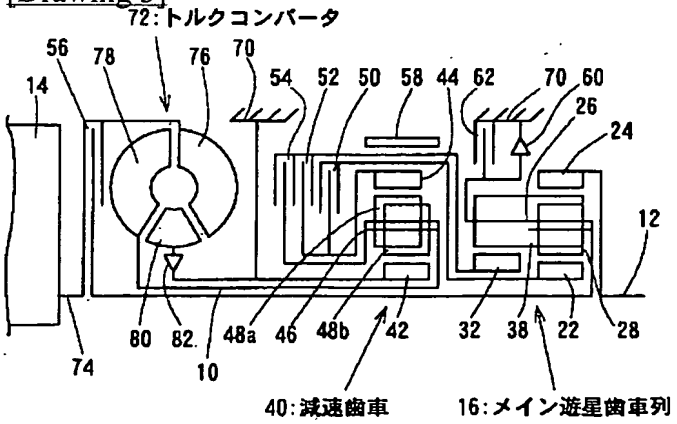
[Drawing 1]



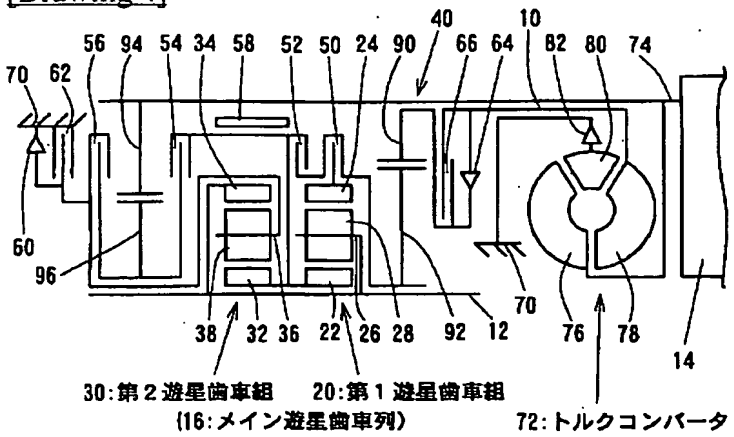
[Drawing 2]

	50	52	54	56	58	62	60
1st	○						○
2nd	○				○		
3rd	○	○					
4th	○		○				
5th	○			○			
6th			○	○			
7th		○		○			
8th				○	○		
R−1		○				○	
R−2			○			○	
L−1	○					○	

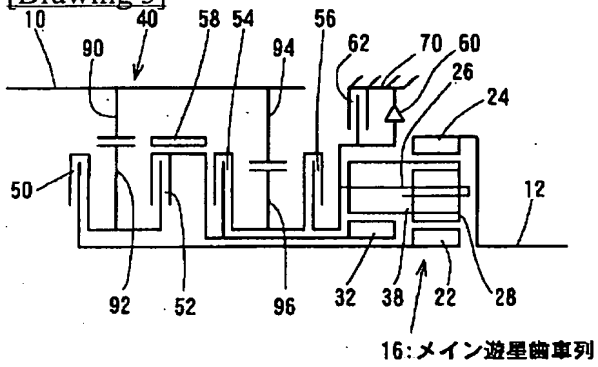
[Drawing 3]



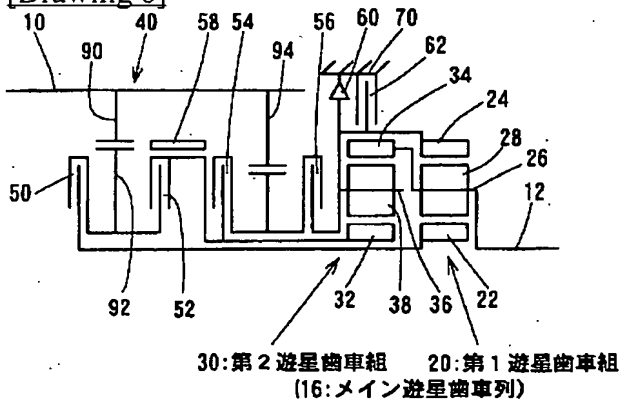
[Drawing 4]



[Drawing 5]



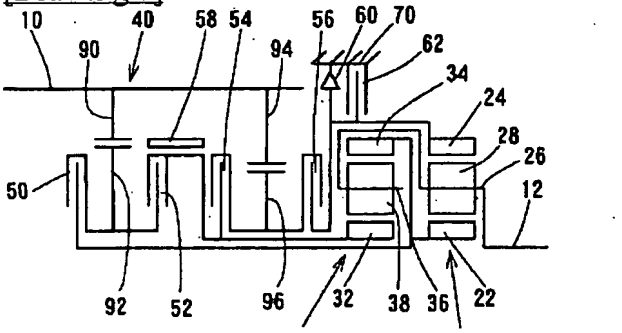
[Drawing 6]



[Drawing 12]

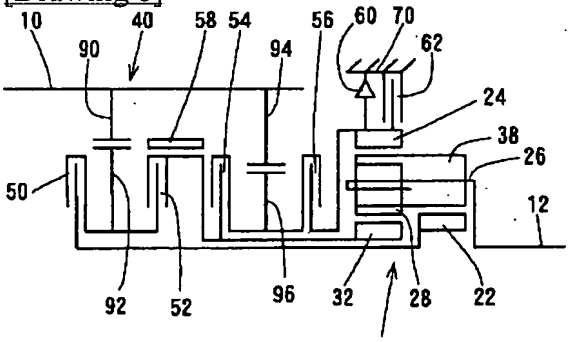
	50	52	56	58	68	60	64	84
1st	○				○	○		
2nd	○	○			▽		○	
3rd	○		○				○	
4th	○	○	○					
5th		○	○		○			
6th			○	○	△			
R		○			○			○
L-1	○			○	○			
L-2	○	○			○			
L-3	○		○		○			

[Drawing 7]



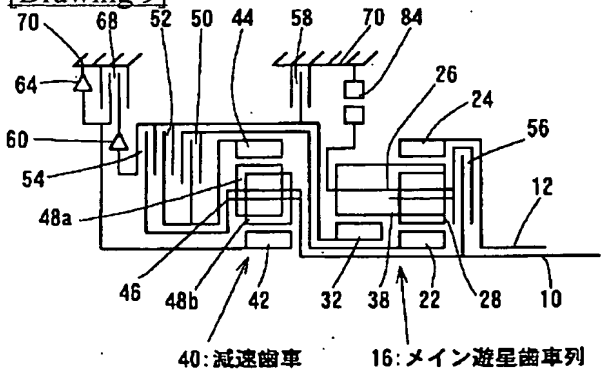
30:第２遊星歯車組　20:第１遊星歯車組
(16:メイン遊星歯車列)

[Drawing 8]



16:メイン遊星歯車列

[Drawing 9]

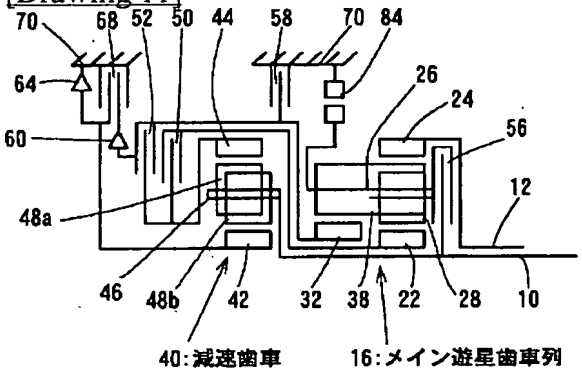


40:減速歯車　16:メイン遊星歯車列

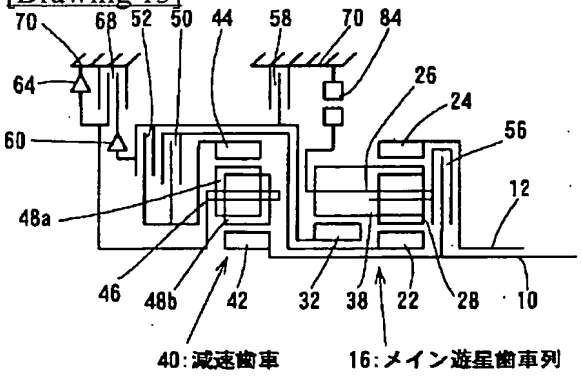
[Drawing 10]

	50	52	54	56	58	68	60	64	84
1st	○					○		○	
2nd	○	○				▽	○		
3rd	○		○				○		
4th	○			○			○		
5th		△	○	○					
6th		○		○		○			
7th				○	○	△			
R-1		○				○			○
R-2			○			△			○
L-1	○				○	○			
L-2	○	○				○			
L-3	○		○			○			
L-4	○			○		○			

[Drawing 11]



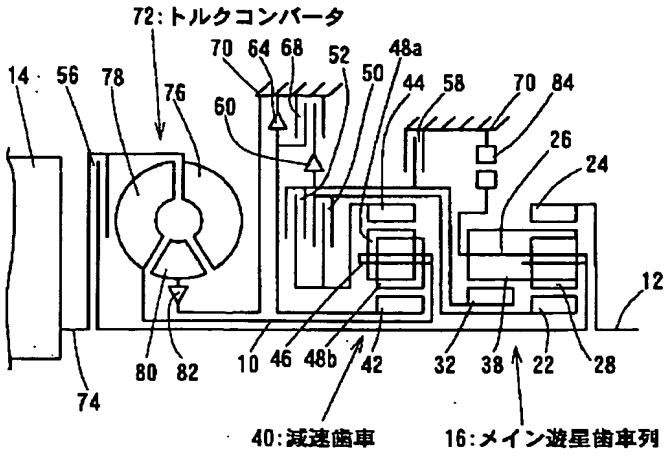
[Drawing 13]



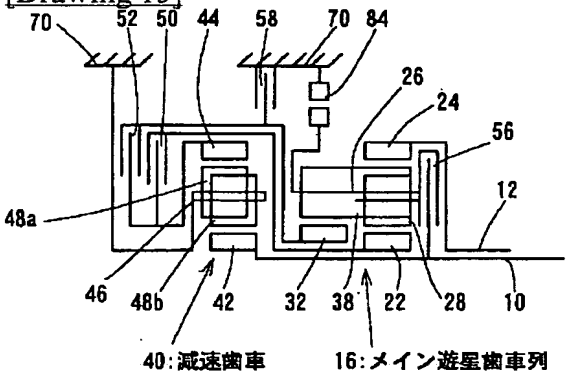
[Drawing 16]

	50	52	56	58	84
1st	○			○	
2nd	○	○			
3rd	○		○		
4th		○	○		
5th			○	○	
R		○			○

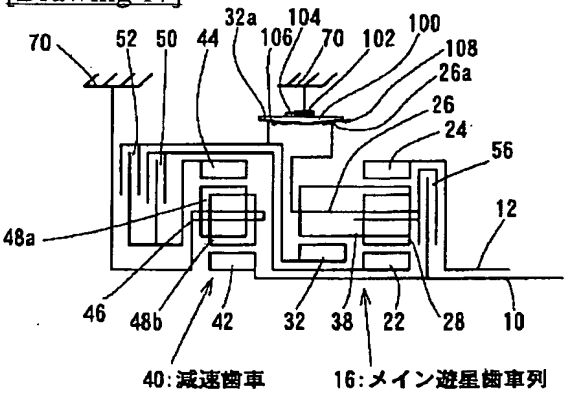
[Drawing 14]



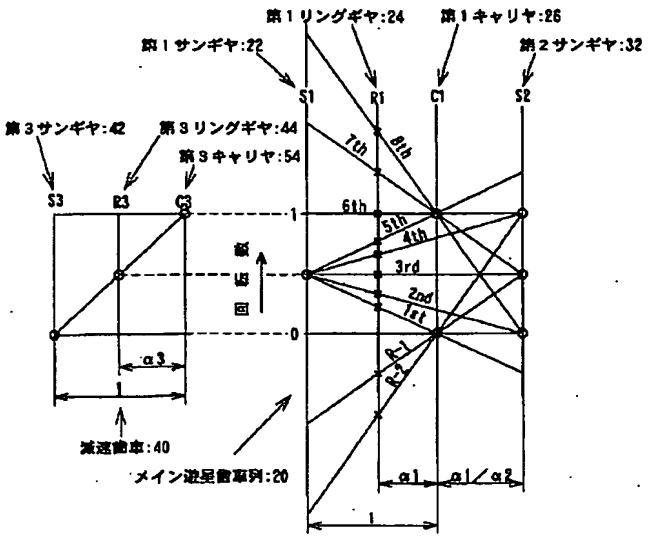
[Drawing 15]



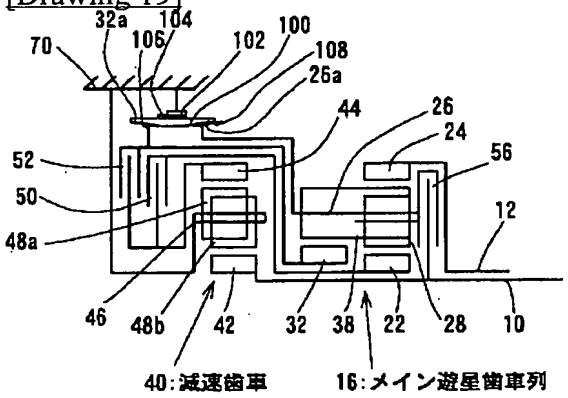
[Drawing 17]



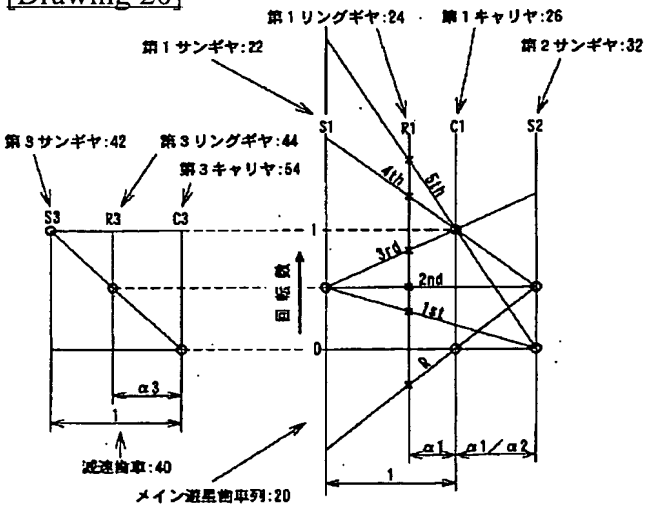
[Drawing 18]



[Drawing 19]



[Drawing 20]



[Translation done.]